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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/773,244	02/09/2004	Tomoyasu Aoshima	T2171.0214	7164
32172	7590	08/23/2006	EXAMINER	
DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP			AHMED, SHAMIM	
1177 AVENUE OF THE AMERICAS (6TH AVENUE)				
41 ST FL.				
NEW YORK, NY 10036-2714			ART UNIT	PAPER NUMBER
			1765	

DATE MAILED: 08/23/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/773,244

Applicant(s)

AOSHIMA, TOMOYASU

Examiner

Shamim Ahmed

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 June 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed 6/13/06 have been fully considered but they are not persuasive. Applicants argue that Wolf does not teach selectively and anisotropically etching the silicon substrate with alkali etchant.

In response to the argument, examiner states that the argument is not persuasive because Wolf clearly shows anisotropic etching of silicon substrate is performed with alkali etchant (as shown in the rejection).

Applicants also argue that Burns et al do not teach forming film stress relaxing groove.

In response, examiner states that the argument is not persuasive because Burns et al illustrate that separate levels of etch depth is formed (figure 2b) and a second mask encompassing all the etched depth (figure 2c).

Therefore, burns et al shows at least another groove is formed other than the mask opening and additionally, Burns et al also shows more than one opening in the masking layers (figures 1B-1D).

Therefore, the previous office action is repeated herein as follows: along with new rejection as respect to new claims.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

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invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1 and 2 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kuroi et al. (U.S. Patent No. 5,956,600), in view of Wolf et al., Silicon Processing for the VLSI Sra, Vol. 1, Lattice Press (1986).

As to claim 1, Kuroi discloses an etching method comprising the steps of: forming a silicon oxide film (2) on one principal surface of a silicon substrate (1) (column 5, lines 13-15), and then forming a silicon nitride film (3) on the silicon oxide film (column 5, lines 18-30), a thickness T_o of said silicon oxide film (300 Å, column 5, lines 16-17) and a thickness T_N of said silicon nitride film (100 Å, column 5, lines 19-21) being set to Have a film thickness ratio T_o/T_n of 1.25 or larger; selectively etching a lamination layer of said silicon oxide film and said silicon nitride film to form an etching mask made of a left region of said lamination layer (column 5, lines 22-28; Figures 1A-1B); and selectively (column 5, lines 26-28) and anisotropically etching (column 5, lines 30-33; Figure 1B) said silicon substrate (1) by using said etching mask (column 5, lines 28-30).

Kuroi does not expressly disclose use of an alkali etchant. Wolf teaches that orientation-dependent (or anisotropic) etchant are commonly used for wet etching Silicon, including alkali etchant, such as KOH (pages 531-32).

Wolf further teaches that wet etching is beneficial due to low cost, reliability, high throughput, and excellent selectivity with respect to mask and substrate materials (page 529).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use an alkali etchant. One who is skilled in the art would

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be motivated to use a conventional wet etchant, such as KOH, which has the benefits of low cost, reliability, high throughput, and excellent selectivity with respect to mask and substrate materials.

As to claim 2, Kuroi discloses that said film thickness ratio T_o/T_N is set in a range from 1.60 to 3.21 (column 5, lines 16-17, lines 19-21). Kuroi discloses a T_o of 300 Å (column 5, lines 16-17) and a T_N of 100 Å (col.5, lines 19-21) or a film thickness ratio T_o/T_N of 3.

4. Claims 3,11-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Burns et al (5,738,757) in view of Wolf.

Burns discloses a wet etching method comprising the steps of: forming a silicon oxide film (12) on one principal surface of a silicon substrate (10), and forming a silicon nitride film (14) on the silicon oxide film (12) (column 6, lines 56-59, Figure 2A); selectively etching a lamination layer of said silicon oxide film (12) and said silicon nitride film (14) to form a mask opening through a partial region of said lamination layer and to form an etching mask made of a left region of said lamination layer (column 6, line 67., column 7, lines 1-3., Figure 2E); after or before said etching mask is formed, forming at least one film groove (Figure 2D, the right side of silicon nitride film (14) is removed) partially in said silicon nitride (14) (col. 6, lines 61-63); and selectively and anisotropically etching said silicon substrate (10) with alkali etchant (column 5, lines 5-8) by using said etching mask (column 6, line 67 column 7, lines 1-3, Figure 2F).

Wolf discloses that KOH is an orientationdependent (or anisotropic) etchant (pages 531-32).

Burns does not expressly disclose that the groove is a stress relaxing groove, said film stress relaxing groove relaxing film stress applied to said mask opening.

However, Wolf teaches that that nearly all thin films are in a state of internal stress, either compressive or tensile (pages 1 14-1 15). Stressed films either expand or contract parallel to the substrate surface (page 114). Because the silicon nitride film (14) is subjected to internal stresses, the groove would inherently function as a stress relaxing groove.

Moreover, because the method of Burns is the same as the Applicant's claimed elements, the same results are expected, including relaxing film stress applied to said mask opening.

5. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Burns, in view of Wolf, in further view of Streetman, Solid State Electronic Devices, Prentice Hall. (1990).

Burns does not expressly disclose that at least one film stress relaxing groove is formed surrounding said mask opening.

However, Streetman teaches that semiconductor devices are batch fabricated and a plurality of identical features are built on a single wafer to keep the cost of each device fairly low (page 332).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form a plurality of groove, including grooves surrounding the mask opening.

One who is skilled in the art would be motivated to reduce costs by batch fabrication of devices.

6. Claims 1-2,5-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kuroi et al. (U.S. Patent No. 5,956,600), in view of Golovchenko et al (6,464,842) and Murakami (6,508,946).

Kuroi teaches above but fails to teach etching the silicon substrate selectively and anisotropically to form through hole in the silicon substrate with etch-stop of silicon nitride material.

However, Golovchenko et al teach that silicon substrate is conventionally anisotropically etched with alkali etchant with an etch-stop of silicon nitride layer (col6, lines 23-60) for efficiently making aperture in the substrate.

Additionally, Murakami teaches the anisotropic silicon etchant can be of any kind of alkali etchant such as KOH, TMAH (col.2, lines 3-11).

Therefore, it would have been obvious to one of ordinary skilled in the art at the time of claimed invention to employ combined teaching of Golovchenko et al and Murakami into Kuroi's process for efficiently and selectively etch the silicon substrate without damaging the surroundings.

7. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Burns, in view of Murakami (6,508,946).

Burns discusses above in the paragraph 4 but fails to teach etching the silicon substrate selectively and anisotropically with alkali etchant of TMAH.

However, Murakami teaches the anisotropic silicon etchant can be of any kind of alkali etchant such as KOH, TMAH (col.2, lines 3-11).

Therefore, it would have been obvious to one of ordinary skilled in the art at the time of claimed invention to employ Murakami's teaching into Modified Burns's process for efficiently and selectively etch the silicon substrate without damaging the surroundings.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Hawkins et al (5,141,596) and Taub et al (5,308,442) shows anisotropic etching of silicon substrate with alkali etchant.

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

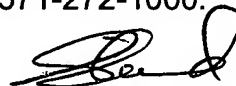
A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shamim Ahmed whose telephone number is (571) 272-1457. The examiner can normally be reached on M-Thu (7:00-5:30) Every Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.



Shamim Ahmed
Primary Examiner
Art Unit 1765

SA
August 17, 2006